

Oct. 5, 1943.

B. M. BIRD

2,331,102

SAND TREATING SYSTEM AND METHOD

Filed Dec. 4, 1940

3 Sheets-Sheet 1

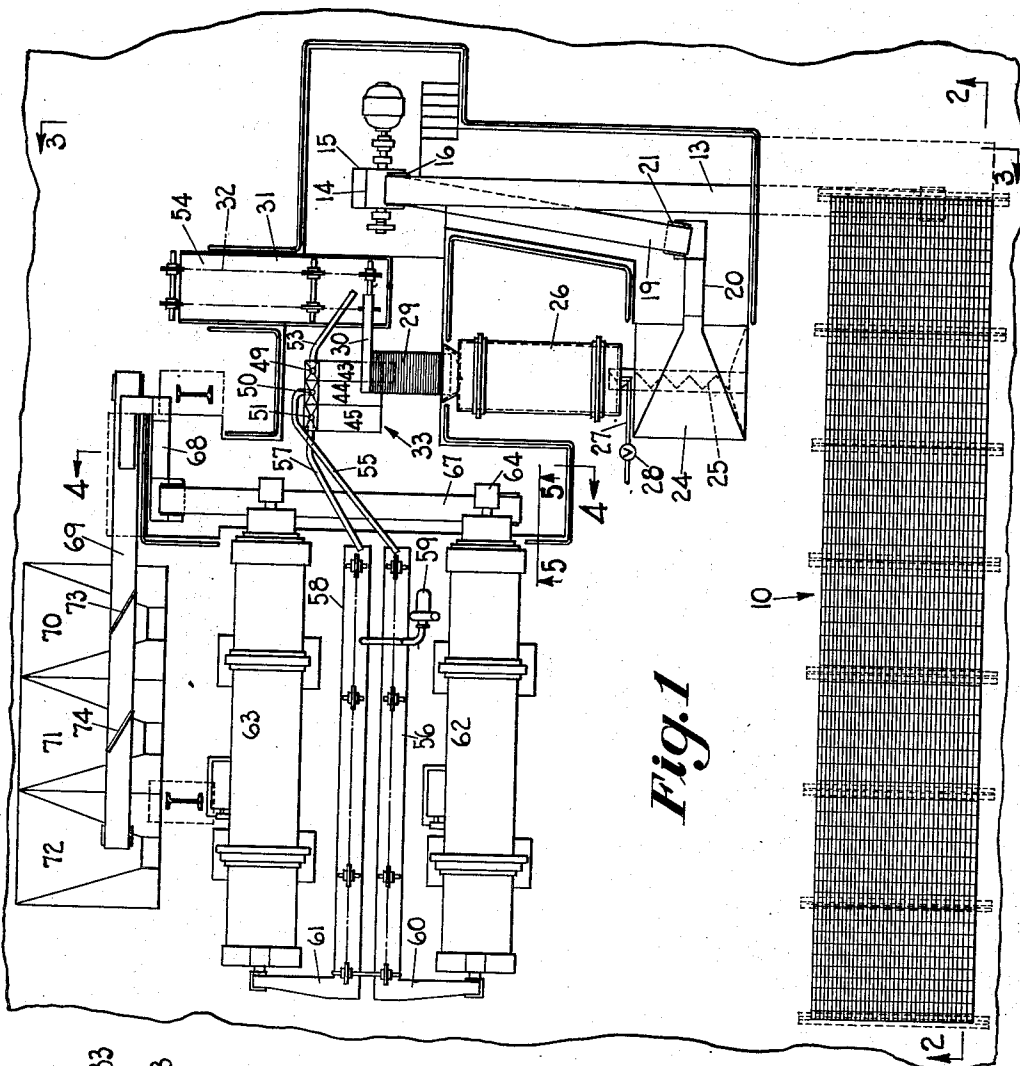


Fig. 1

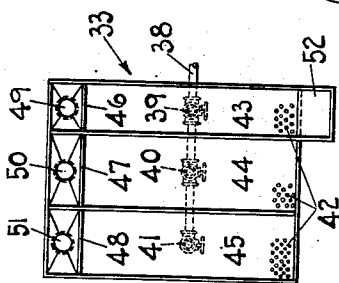


Fig. 6

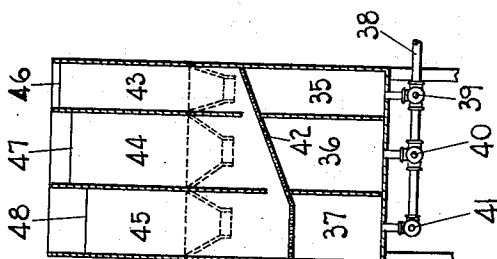


Fig. 7

INVENTORS.
BYRON M. BIRD,
ALBERT C. RICHARDSON,
BY *Chas. M. Nissen,*
ATTY.

Oct. 5, 1943.

B. M. BIRD

2,331,102

SAND TREATING SYSTEM AND METHOD

Filed Dec. 4, 1940

3 Sheets-Sheet 2

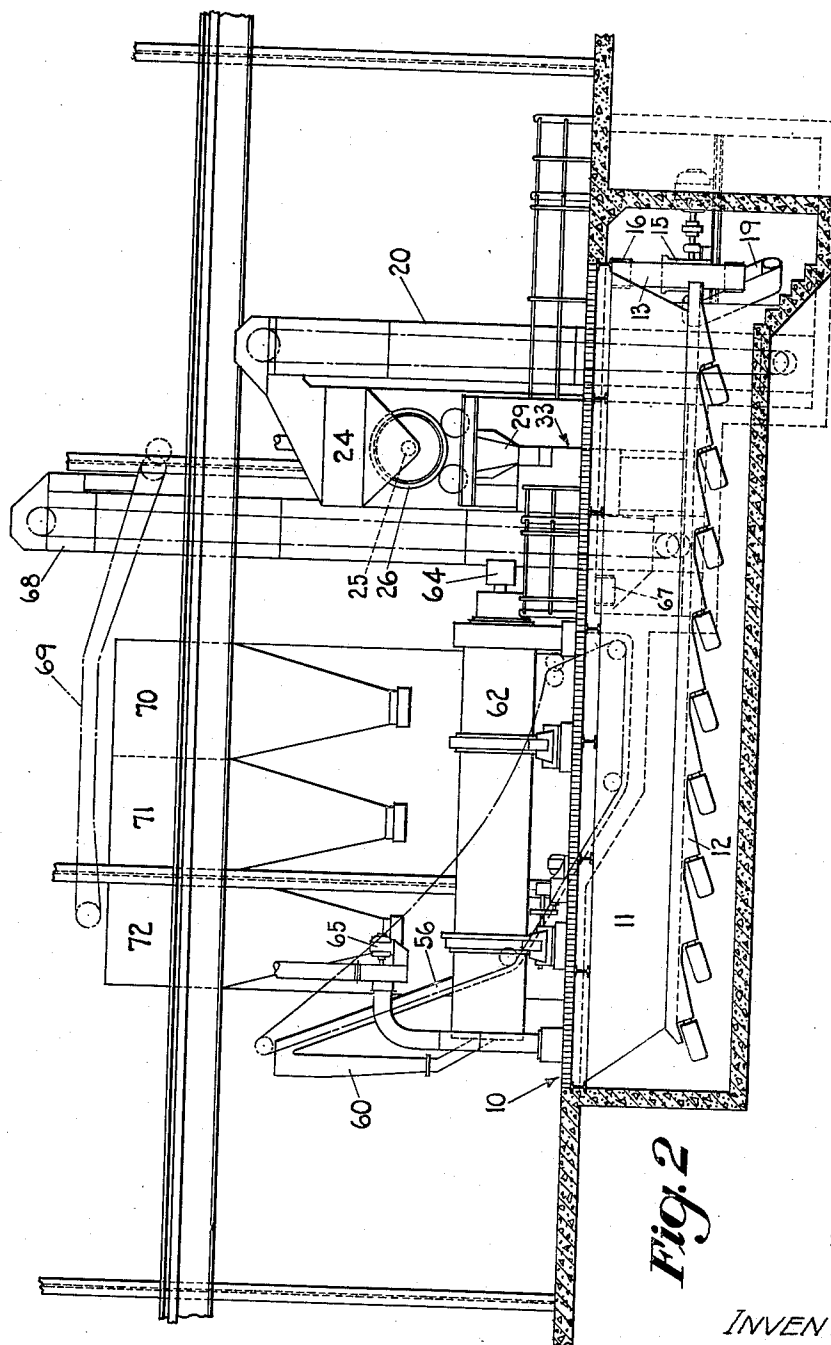


Fig. 2

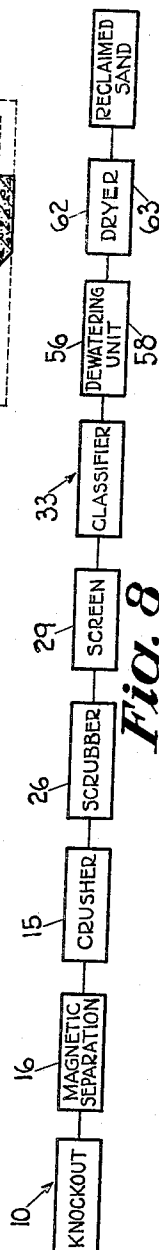


Fig. 8

INVENTORS,

BYRON M. BIRD,
ALBERT C. RICHARDSON,

By Chas. M. Nissen,
ATTY.

Oct. 5, 1943.

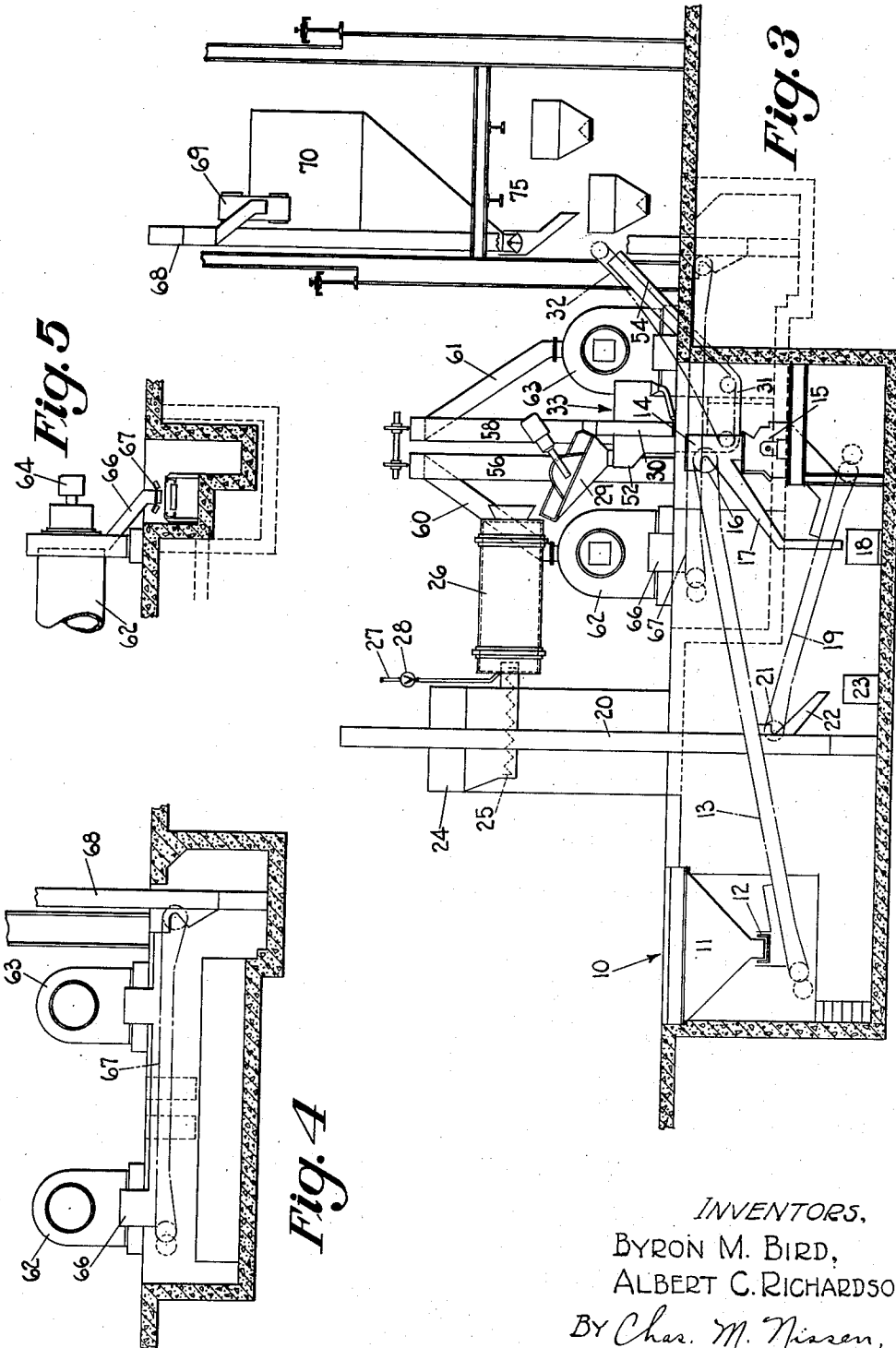
B. M. BIRD

2,331,102

SAND TREATING SYSTEM AND METHOD

Filed Dec. 4, 1940

3 Sheets-Sheet 3



INVENTORS,
BYRON M. BIRD,
ALBERT C. RICHARDSON,
BY *Char. M. Nissen,*
ATTY.

UNITED STATES PATENT OFFICE

2,331,102

SAND TREATING SYSTEM AND METHOD

Byron M. Bird, Columbus, Ohio, assignor to The Jeffrey Manufacturing Company, a corporation of Ohio

Application December 4, 1940, Serial No. 368,524

6 Claims. (Cl. 22—89)

This invention relates to apparatus for and a method of treating sand to condition, or recondition, it for use as foundry sand, either in the making of mold cores or as green molding sand.

An object of the invention is to provide improved apparatus and an improved method as above outlined.

Another object of the invention is to provide a practical method of and apparatus for treating or reconditioning used core sand, such as oil core sand, so that it can be used again.

Another object of the invention is to provide a method of and apparatus for treating molding sand, either new or used, so that it will be of uniform consistency and thus make uniformly good cores or molds.

Another object of the invention is to provide a method of and apparatus for treating molding sand involving scrubbing or cleaning thereof to remove adhering foreign matter, such as spongy carbon, scale or other foreign matter while the sand is in a bath of water.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

In the accompanying drawings,

Fig. 1 is a plan view of a system comprising my invention which may be employed to carry out the method of my invention;

Fig. 2 is a combination sectional and elevational view of the system taken on the line 2—2 of Fig. 1 looking in the direction of the arrows;

Fig. 3 is a combination sectional and elevational view of the system of my invention taken on the line 3—3 of Fig. 1 looking in the direction of the arrows;

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 1 of the drawings looking in the direction of the arrows;

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 1 looking in the direction of the arrows;

Fig. 6 is a plan view showing the upward current classifier which I have used;

Fig. 7 is a sectional elevational view of the classifier of Fig. 6; and

Fig. 8 is a flow diagram of the system and method.

My method and system relates particularly to the treatment of used core sand, such as oil core sand, so that the sand may be substantially free of foreign matter and thereby restored to its original condition or a condition which may be even superior to its original condition. While this is the principal characteristic of my invention,

it is also to be understood that it may be used to treat ordinary molding sand which has been used, or it may be used to treat original sand which contains some impurities or foreign matter thereby to improve its quality for use, either in the making of sand cores or for use as green molding sand.

With respect to the principal feature of my invention, namely the treating of used core sand so that it may be used again, it may be pointed out that core sand when once used tends to form a coating or outer layer of spongy carbon which is apparently due primarily to the fact that the bonding agent such as oil, molasses or other material tends to carbon under the heat of the casting and this spongy coating or layer of carbon precludes the satisfactory reuse of the sand except that in some cases it has been used in relatively small quantities with new sand. My improved method and the apparatus which I provide has resulted in great saving of used core sand because it has been found that by treating or reconditioning said core sand in accordance with my invention all or substantially all of the original sand is recovered to be used again, and this process of recovery can be carried on indefinitely because the quality of the sand appears to improve rather than degenerate by virtue of the reconditioning or retreating process.

In the accompanying drawings, I have illustrated one form of apparatus which may be employed to carry out my improved method, it being understood of course that numerous modifications of the apparatus may be made.

Referring particularly to Figs. 1 and 2 of the drawings, there is seen at 10 a knockout grating upon which the used sand, that is core sand or green sand as the case may be or even new sand which is to be treated, is received. In the case of used core sand it will be knocked out of the castings by any well-known means such as a casting vibrator and fall on the grating 10. The grating 10 is of a large mesh, for example the openings may be as large as 2" by 4", and thus practically all of the sand, even used core sand, will freely pass through it and any large particles which do not pass through can be easily broken up so that they do pass through.

Below the grating 10 is a receiving hopper 11 which catches the sand and directs it to a vibratory feeder 12 which may be of the electromagnetic type such as those known in the art as the Traylor Feeders manufactured by The Jeffrey Manufacturing Company of Columbus, Ohio. The feeder 12 when energized will feed

the sand to a belt conveyor 13 by which the sand is conveyed to a delivery chute 14 which feeds a swing hammer crusher 15. The conveyor 13 preferably has a magnetic pulley 16 which attracts any iron which is delivered to chute 14 and causes it to stay on the belt of conveyor 13 until it is scraped off into an iron discharge chute 17 which directs it to a receptacle 18. The swing hammer crusher 15 breaks up the chunks of material without appreciably reducing the size of any of the sand grains individually thus tending to free each sand grain of other adhering sand grains and thus exposing the entire surface of each grain of sand to be treated as hereinafter described.

Swing hammer crusher 15 discharges onto a belt conveyor 19 which conveys the sand to the boot of an elevating conveyor 20 into which it discharges. The conveyor 19 preferably has a magnetic pulley 21 to catch any iron which is not removed by the magnetic pulley 16 and discharge it by way of chute 22 into receptacle 23. The elevating conveyor 20 discharges the sand into a surge bin 24 which compensates for any variations in the rate of feed of the sand to it to insure continuous operating of the equipment which follows the surge bin.

The surge bin 24 has a hopper-like bottom in which is mounted a screw conveyor 25 which conveys the material into a rotary pebble mill 26 or other scrubbing device. Water is fed to the pebble mill 26 by way of pipe 27 having a control valve 28. As hereinafter pointed out more completely the pebble mill 26 is not used as a mill in the sense that it grinds the sand, but is used as a scrubber to free the sand grains of foreign matter.

In the practice of my invention the sand to be treated is preferably continuously fed to the pebble mill 26 and also continuously fed therefrom. This pebble mill is of the rotating type and its function is to scrub the individual particles of sand to remove the adhering coating of foreign matter, such as spongy carbon, or any scale which may be attached to the sand particles. It is also effective to separate any adhering grains of sand which have not been previously separated by the swing hammer crusher 15. This scrubbing action takes place in a bath of water which is preferably maintained at roughly a 25% solution of water and a continuous scrubbing action has been found effective particularly in a bath of water to remove all foreign material from the sand grains thereby conditioning them to the most desirable condition possible.

I have found from experiment that where an oil core sand is being retreated, the pebble mill 26 preferably employs steel punchings as a loose material to scrub the sand. In practice I have used punchings of the size $\frac{3}{8}$ " by $\frac{1}{8}$ " which have been very satisfactory. Flint pebbles have also been used as the loose scrubbing material with satisfactory results but my experiments indicate that while flint pebbles are more satisfactory with foundry sand, the steel punchings give better results with core sand. The water, sand and foreign matter which flow out of the pebble mill 26 are received on a vibratory screen 29 which has as its principal function the removal of any large particles, this screen being a fairly fine screen. It is particularly effective to remove particles of coke which are placed in sand cores as is well known to those skilled in the foundry art, which coke tends to float on

the liquid in the pebble mill 26 and is often of considerably larger size than the sand grains and thus is easily removed by the screen 29. This foreign matter which is removed by the screen 29 is discharged by way of chute 30 into a sludge tank 31 provided with scraper conveyor mechanism 32 for removing the settled sludge as hereinafter described more completely.

The grains of sand as well as the foreign matter such as carbon which has been removed therefrom will pass through the screen cloth of screen 29 where it is received by a hopper-like structure and directed to an upward current classifier 33, or other type of gravity separator such as a jig of the type well-known in the mining or coal cleaning art. In this installation the upward current classifier is preferred because of its simplicity and cheapness.

The structure of the upward current classifier which I have employed with satisfactory results is shown particularly in Fig. 6 and 7 of the drawings. This classifier comprises a container 34 having three bottom cells 35, 36 and 37 supplied with water from a pipe 38 through individual control valves 39, 40 and 41. Above the cells 35, 36 and 37 is a perforated plate 42 which slopes downwardly over the cells 35 and 36 but is substantially horizontal above the cell 37. Formed as substantial continuations of the cells 35, 36 and 37 and directly above each of them respectively are cells or compartments 43, 44 and 45 provided with overflow weirs 46, 47 and 48 over which the liquid flows into receiving compartments 49, 50 and 51, respectively.

By reference to Fig. 6 of the drawings it will also be seen that the cell or compartment 43 has an extension 52 which first receives the mixture of water, sand grains and foreign matter which passes through the screen 29. The function of the upward current classifier 33 is of course to effect a separation of the pure sand grains from the foreign matter. In operation the mixture from the screen 29 flows into the extension 52 and into cell or compartment 43. The upwardly flowing current which flows through pipe 38, valve 39 and bottom cell 35 and thence upwardly through cell or compartment 43 has a relatively low velocity; and so it is effective to classify the sand and foreign matter so that the heavy sand grains will move downwardly against the upwardly flowing water while the spongy carbon and other foreign matter, which has a much lower specific gravity than sand, together with any very fine material, and slime will flow over the weir 46 and into the receiving compartment 49 from where it flows by pipe 53 (see Fig. 1) to the sludge settling tank 31.

It is thus evident that all foreign matter, slime and carbon, will be removed by the upward current classifier in compartment 43 and delivered to the sludge tank 31 where it will settle to the bottom and be removed by the scraper conveyor 32 up the inclined wall thereof as clearly illustrated at 54 in Fig. 3 of the drawings. As above mentioned, the sand grains which are the desired size, that is, all of them except the very fine ones, due to their high specific gravity will accumulate on the plate 42 since they move downwardly in the cell 43, and since they are maintained in a continuous agitation by the water flowing upwardly through the plate 42 they will slide downwardly along said plate 42. The valve 40 is so adjusted that the upwardly flowing current flows at a higher rate therethrough than through the cell 35, and consequently the water

through cell 44 flows at a higher rate than that through cell 43. This is effective to carry over the smaller particles of sand and in one typical installation the sand from 120 mesh to 70 mesh is carried over in this compartment flowing over the weir 47 to receiving compartment 50. The larger sand grains continue to move downward to a position above cell 37 through which the water flows upwardly at a still higher rate than that through cells 35 and 36, and consequently the sand is preferably carried off through compartment or cell 45 over weir 48 into receiving compartment 51. In other words, the two compartments 44 and 45 are primarily for obtaining two different size ranges of sand grains, and in many installations this separation will not be necessary or even desirable in which case a two-compartment upward current classifier will be used, the first compartment to remove the very fine sand which is not fed for reuse, the slimes, the carbon and any other foreign matter, the cleaned sand all being removed in the second compartment. If a jig is used, the sand of course will form on the bottom stratum, and all other material such as the fines, slime, carbon and foreign matter will be discharged over the weir as the low gravity material and will be conveyed to the sludge tank.

In the system disclosed I have shown apparatus for separating the reconditioned sand into two size ranges which are subsequently separably dewatered and dried. This separation and separate drying is not at all essential to my system or method in its broader aspects, but under certain conditions may be desirable in case two different size ranges of sand are desired.

Referring particularly to Fig. 1 of the drawings it will be seen that the sand and water delivered to receiving compartment 50 flow by way of pipe 55 to an elevating dewatering scraper conveyor 56, and the sand and water delivered to receiving compartment 51 flow by way of pipe 57 to an elevating dewatering scraper conveyor 58. The water which accumulates in the bottom of the conveyors 56 and 58 is recirculated by a pump 59 being delivered to the system and used by the upward current classifier 33 and/or the pebble mill 26.

Referring to Fig. 2 of the drawings, it will be seen that each of the elevating scraping conveyors 56 and 58 has an upwardly inclined portion which insures complete dewatering of the sand, that is, the removal of all free flowing water, and this sand is then delivered to chutes 60 and 61 from conveyors 56 and 58, respectively, by which it is directed to rotary dryers 62 and 63, respectively. These rotary dryers 62 and 63 are of well-known construction and briefly described comprise rotary cylinders which slope slightly downwardly from the receiving end at the rear to the discharge end at the front, the interior walls of which are provided with projections which lift the material to be dried, which in this case is wet sand, and let it fall through a heated atmosphere provided by a gas burner, that associated with the dryer 62 being indicated at 64, which extends into the front end thereof and shoots a flame of burning gas into the dryer.

An exhaust gas fan means 65 is shown associated with the dryer 62, there being similar exhaust gas fan means associated with the dryer 63 to remove the exhaust gas which collects moisture delivered from the sand in the process of drying the sand and delivers it outside the building which contains the equipment.

As illustrated particularly in Fig. 5 of the draw-

ings, at its forward end the dryer 62 has a discharge chute 66 which delivers the dried sand onto a collecting belt conveyor 67. Dryer 63 also discharges onto the belt conveyor 67 or, if desired, it may discharge onto another belt. In the first instance there will be a mixing of the sands delivered by the dryers 62 and 63 if they are operating simultaneously, while in the second instance such a mixing will not take place. It is of course possible to operate alternately the dryers 62 and 63 and thus maintain their productions separate by discharging from only one of them at a time onto the single belt 67.

As best illustrated in Fig. 4 of the drawings, the belt 67 delivers the dried and reconditioned sand into the boot of an elevating conveyor 68 which elevates it and delivers it to a distributing belting conveyor 69 by which it may be distributed to any one of three hoppers 70, 71 and 72. The bin into which the sand on distributing conveyor 69 discharges may be governed by controllable discharge plates 73 and 74. The green sand ready for reuse is thus stored in the bins 70, 71 and 72, and it may be separated according to size into one or more of said bins if desired. From any of the bins 70, 71 and 72 the reconditioned sand may be obtained for use by way of discharge hopper and chute mechanism, one of which is illustrated at 75 associated with the bin 70 in Fig. 3 of the drawings.

In the operation of the mechanism comprising my invention with the consequent carrying out of the method of my invention, the sand to be treated or retreated, be it used core sand, used foundry sand or new sand, any one of which may have foreign matter therein, is first received by the grating 10 which of course keeps large particles, such as castings, core flasks and the like in their proper place, from which the sand is conveyed to the swing hammer crusher 15, the metal being removed at least in part before the sand to be treated is delivered to said swing hammer crusher. Said crusher 15 is effective to break up the sand into individual grains, at least to a large extent. From the crusher 15 the sand is conveyed to surge bin 24, any iron passing through the crusher being removed by the magnetic pulley 21. In the surge bin 24 the sand to be treated which may be called the impure sand is fed to the scrubbing device which in this case is a pebble mill 26 to which sufficient water is fed to form a bath for the sand, an approximately 25% solution of water having been found desirable.

Within the pebble mill 26 a thorough scouring action is performed upon the individual sand grains, and if any sand grains tend to adhere to each other they will be separated during the process of this scouring action. The scouring or scrubbing action will remove any adhering particles of carbon or foreign matter from the sand grains thus conditioning them for future separation. This mixture of material, that is, water and sand and foreign matter, will have a very high specific gravity. A light material, such as coke particles which are present because of the fact that coke is frequently placed in sand cores to provide for breathing thereof will tend to float and consequently will not be effectively scoured if any sand grains adhere thereto. These coke particles will generally be considerably larger than the sand grains, and as the material flows out of the mill 26 they will of course include water, clean sand grains, coke particles or other large particles of foreign matter and small particles of carbon, scale or other foreign matter. The larger parti-

cles will be removed by the screen 29 and delivered to the sludge tank 31 while the small particles with the water pass through said screen 29 and into the upward current classifier 33. This classifier will act as was described in detail above, first to separate the slimes, fine sand, carbon and other foreign matter, and deliver it to the sludge tank 31. The pure sand is thereafter delivered into two sizes in the system and method disclosed, whereas in other systems and methods within my invention it will be delivered only as a single size of clean sand, for subsequent drying and storing. In the system and method disclosed one size range of sand, for example 70 mesh to 120 mesh, is delivered to the dewatering conveyor 56 and another size range of sand, for example, 70 mesh plus to dewatering conveyor 58. The dewatering conveyors 56 and 58 are effective to reduce the water content of the clean sand appreciably, for example, to approximately 20%, and this dewatered but wet sand is delivered by chutes 60, 61 to dryers 62, 63 where it is dried to a completely satisfactory state of dryness and delivered to the conveyor 67 which then delivers it to the elevating conveyor 68, thence to distributing conveyor 69 and other storage bins 70, 71 and 72, or any one of them as desired. If desired, each of the dryers 62, 63 may have a belt conveyor comparable to the single conveyor 67 and a separate elevating conveyor comparable to the elevating conveyor 68 which may deliver it into a separate storage bin instead of the three storage bins 70, 71 and 72.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended, and I therefore wish not to be restricted to the precise construction herein disclosed.

Having thus described and shown an embodiment of my invention, what I desire to secure by Letters Patent of the United States is:

1. The method of treating used foundry sand, comprising scrubbing the sand in a liquid bath to separate pure sand from foreign matter, screening the wet sand and foreign matter to remove foreign matter of large size, treating the screenings by an upward flow of water to produce products of usable sand and foreign matter, directing the separated products along different paths, and drying the usable sand.

2. The method of treating sand, comprising scrubbing the sand in a liquid bath to separate pure sand from foreign matter, screening the wet sand and foreign matter to remove foreign matter of large size, treating the screenings by an upward current of water to produce products of usable sand and foreign matter, and directing the separated products along different paths.

3. The method of treating used foundry sand, comprising scrubbing the sand in a liquid bath to separate pure sand from carbonized binder foreign matter, treating the sand and foreign matter by an upward current of water to produce products of usable sand and foreign matter, and directing the separated products along different paths.

4. Apparatus for cleaning used foundry sand comprising means for crushing large particles formed by adhering sand grains, scrubbing means comprising a rotary pebble mill having loose scrubbing material therein for removing adhering foreign matter from the sand grains, means for supplying water to said scrubbing means, means for conveying the used sand from said crushing means to said scrubbing means, means fed by said scrubbing means for separating the sand grains from the foreign matter, means for drying the cleaned sand, and means for storing said cleaned sand.

5. Apparatus for cleaning used foundry sand including a rotary scrubber having loose particles therein to aid the scrubbing action on the said grains during rotation of said scrubber, means for supplying water to said scrubber, a screen positioned to receive material from said scrubber and remove large particles of foreign matter, and an upward current gravity separator adapted to separate the clean sand from the foreign matter.

6. Apparatus for cleaning used foundry sand including a rotary scrubber having loose particles therein to aid the scrubbing action on the said grains during rotation of said scrubber, means for supplying water to said scrubber, a screen positioned to receive material from said scrubber and remove large particles of foreign matter, and a gravity separator adapted to separate the clean sand from the foreign matter.

BYRON M. BIRD.